Efficient Ad-Hoc On-demand Distance Vector Routing Protocol using Link State Algorithm

Mustafa Jasim AL-Jubori
Department of Computer Engineering,
VIT Colllege, Pune University

Prof. S. S. Pawale
Department of Computer Engineering,
VIT College, Pune University

Prof. S. R. Shinde
Department of Computer Engineering
VIT College, Pune University

ABSTRACT
We developed a new algorithm for route discovery, nodes management, and mobility handling for on-demand cache routing on mobile Ad-Hoc networks (MANET). We used Ad-Hoc On demand Distance Vector (AODV) protocol as the better known reactive protocol, as well as using Link State algorithm of the Optimize Link State Routing (OLSR) protocol together. We used two levels of caches memory L-1 and L-2 along with link state routing table for each node. Which maintaining by using the algorithm of OLSR, which working under the AODV protocol. For mobility handling, we used link state algorithm working under AODV to manage node addition, deletion and movement in the network efficiently. We used the Network simulator NS-2 version 2.29 to show the results comparing with the AODV used just cache memory, and comparing with AODV without cache memory. The results shows that our algorithms outperform comparing with AODV without cache memories, and AODV with two levels of cache memory on packet delivery rate, where the link state routing protocol is used to distribute and maintain routing information among various nodes within a domain by using two messages which are Hello messages and Topology Control messages (TC) .

Keywords
MANET,Ad-Hoc On demand Distance Vector (AODV) protocol, Optimize Link State Routing (OLSR) protocol, route cache, route discovery, mobility management, mobile functions management.

1. INTRODUCTION
Mobile Ad-Hoc Network (MANET) is a collection of two or more mobile devices or nodes or terminals with wireless communications and networking capability that communicate with each other without preorganization, no centralized administrator also the wireless nodes that can dynamically form a network to exchange information without using any existing fixed Infrastructuresand each node can dynamically moving in any direction. The absence of fixed infrastructure in a MANET poses several types of challenges. The biggest challenge among them is routing information from source to any available destination. The most important issue in MANET is the routing, because more efficient routing causes more utilize network bandwidth, more power efficiency, also may increase the secure of an overhead congestion overall the Ad-Hoc wireless network. There are different protocols in MANET's used many routing strategies depend on networkstructure. The most important routing protocols used with MANET can be categorized as Table-driven(proactive), and On-Demand(reactive).

Section(1) contain the background of the mobile Ad-Hoc networks MANET and the important protocols, Section(2) contain the suggested approach, section(3) contain the algorithms of the proposed working in the privies section, section(4) showing the performance evaluation, section(5) contains the conclusion, finally section(6) contains the references.

1.1 Optimized link-state routing protocol
Optimized Link State Routing Protocol (OLSR) is a table driven (proactive protocol), i.e. exchanges topology information with other nodes of the network regularly. But this protocol is designed to be more efficient with MANET because the routing calculation is performed by some node not by all nodes same in conventicle link state protocols or others proactive protocols. These node are responsible to calculate the routing table are call MultiPoint Replay (MPR) nodes. Whereeach node selects set of its neighbour nodes as "multipoint relays" (MPR).The MPR nodes are responsible for diffusion control traffic messages in the entire network for routing calculating. Link-state routing protocol also exchange Hello message periodically to update topological information in each node in the network. OLSR is specifically designed to operate in the context of MANETs, i.e. in bandwidth-constrained, dynamic networks but stile not active with large MANET [2],[8].

1.2 On-demand routing protocols (Reactive)
These protocols are also called reactive protocols since they don't maintain routing information or routing activity at the network nodes if there is no communication and there are no pre calculation of routing table for whole network. If a node wants to send a packet to another node then this node has to find path by using on-demand manner and establishes the connection in order to transmit and receive the packet [3]. The route discovery usually occurs by broadcasting the route request packets throughout the network. There are a lot of protocols using on-demand strategy but different manners such as AODV, DSR, etc. AODV performs better than DSR for high mobility cases but faces the problem of high routing and MAC load as compared to DSR[6],[7]. This is because DSR resorts to an aggressive use of caching of routes while AODV does not thus there are many researches for solving the problems that faced with the AODV by using cache memory, that making AODV has properties of both DSDV which is free of loop and properties of DSR after using cache memory.

2. THE ON-DEMAND CACHE ROUTING ALGORITHM USING ALGORITHM OF OLSR

The AODV routing protocol is responsible on Route Discovery Algorithm (RDA) by using three control messages are "rout request" message RREQ , "reply request" message RREP, and "error request" message RERR . We suggested to used the algorithm of OLSR protocol working under the AODV as part of the AODV protocol for handling the Mobility Handling Algorithm (MHA) by using Hello message, where each node is responsible on sending Hello message whenever it joint to a network or changed its position, also sending Hello message periodically to know who are its current neighbours, where the neighbour information are stored in the *neighbour set* of each node. For tracking the link state between a node and its neighbours, using *tuple set* to store any available information about the neighbours links such as types of link; synchronized link (SYN)(e.g. unidirection) and asynchronized link (ASYN) (e.g. bidirections) and the interface addresses of local node and neighbour node storing in the link tuple . From these information each node will select set of its one hop-neighbours as Multi-pint Relay (MPR). The MPR nodes is the responsible to generate Topology Control Message (TC). TC is used for Node Functions Management (NFM) by calculating routing table. Where the MPR nodes are periodically send TC messages to calculate partial topology of the network and for update the routing table of its selectors.

Each node contained the following information sets for state maintenance:

1. Two levels of cache memory which are maintains through route discovery algorithm route maintenance. Where the level one of cache memory (L1) is include the new path by reply messageRREP that came from the destination or any intermediate node has the route. And second level of cache memory (L2) is include the old route stored in the L1 , when the time exceed of storing a route in L1 after last using will shift to L2. Where also these caches memory updated by error message RERR [1].
2. Routing table: MPR nodes are responsible on update the partial topology of the network which is maintains by periodically sending the topology message "TC" with the purpose of providing each node in the network with sufficient link-state information to allow route calculation with routing table.
3. Neighbour set: contains all information about the neighbours tuples to keep track of the a node's neighbour status, including activates time willingness and valid time type of link state (symmetric, asymmetric) etc. this information include one and two hop tuple, is updates by Hello message.

4. MPR set: this include set of node selected as MPR, while MPR's selector is select it's MPR depend on neighbour set and tuple set record set of MPR selector tuples and describe neighbour which is select just one hop neighbour that have symmetric links. where the MPR nodes are responsible to generate TC message for updating Routing table.

5. Link tuple: to keep track of link state between the node and its neighbours, there are two type of state synchronized link (SYN)(e.g. unidirection) and synchronized link (ASYN) (e.g.bidirections) and the interface addresses(e.g.end point of the link) of local node and neighbour node is updates by Hello message.

3. THE ALGORITHMS OFPROPOSED SYSTEMS

3.1 Source started looking for path to a destination for sending data packet

♦ First it check the cache memory level one L1 because it supposed to be containing the newest paths.
If; there is no path it going to seek in cache memory in level two L2, if there is no path then it going to seek in link state table.

♦ Wherever source found the path to the
particular destination it will unicast the data packet to that destination after attaching the path in the packets.

♦ Otherwise; if there is no path or the path is invalid; the node will be going to the Route Request Algorithm.
♦ When get reply packet from the destination or from intermediate node will extract the path
from the reply packet and attaches to data packets.
♦ When the intermediate node cannot reach the destination it will reply the Error Route packet.

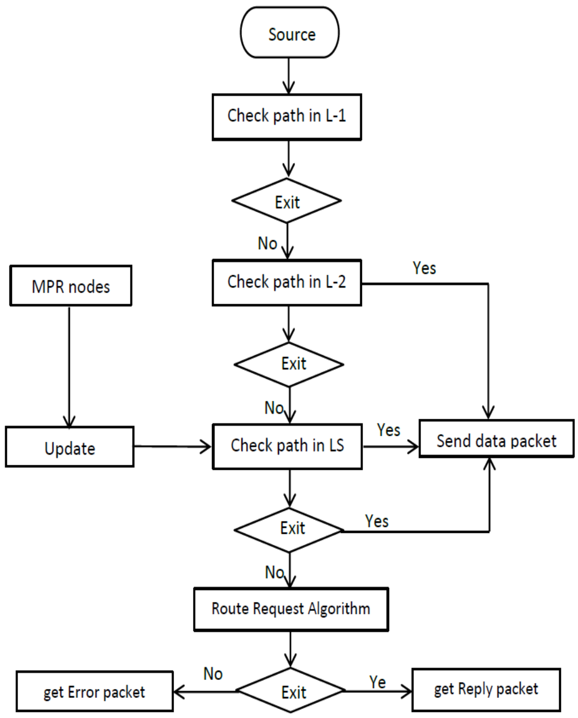


Fig 1: flowchart of the start of sending destination.

3.2 Rout Request Algorithm scenario

♦ As we mentioned when a source does not find path to a destination it will start a Route Request Algorithm (RRA).
♦ The (RRA) starts when the source begin to send Rout Request message (RREQ) to its neighbours, after attaching its ID, and the destination ID, and unique identifier number for the packet.

♦ When the node receive the coming RREQ it will extract the path, and check whether itself the intended destination
If; yes it will send Route Reply message (RREP) on the reverse path in the RREQ.
♦ If not itself the intended destination, will check whether it has path to the destination.
If; path is available will send (RREP) on the reverse path in the RREQ.
Otherwise the intermediate node will re-forward the RREQ its neighbours.
♦ If any of the intermediate node is not the destination as well as it cannot re-forward the RREQ, it will return back the Route Error message on the reverse path in the RREQ.

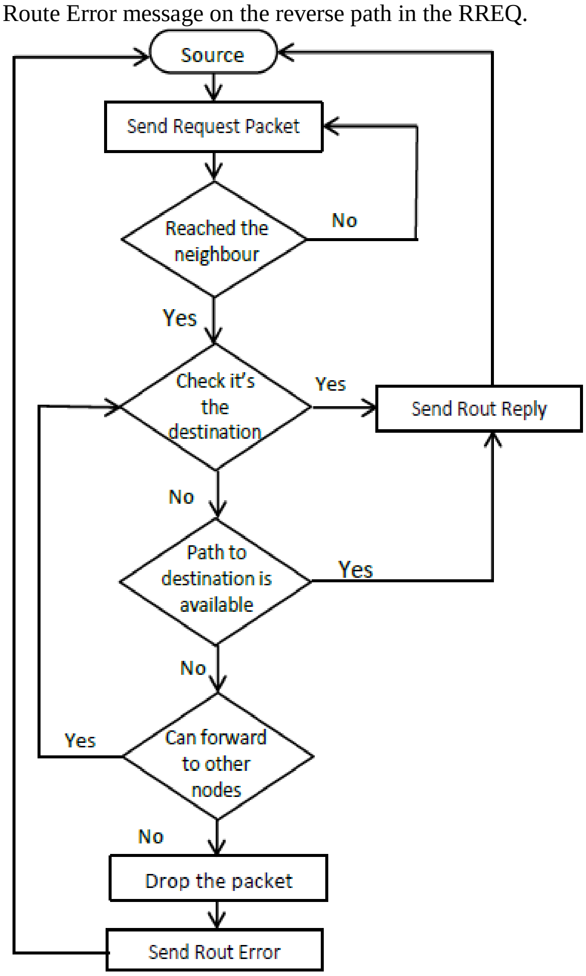


Fig 2: Flowchart of Rout Request Algorithm scenario.

3.3 Mobility Handling Algorithm and Node Function Management

When new node joint in the network, an existing node moved within the network, or it send any message to its neighboursand did not get any acknowledgement will broadcast Hello message as well as periodically send Hello message to manage its neighbours list.
♦ If not get reply from some nodes means there have moved, thus it will update its Route Table (L1,L2,and LS information) by removing each path from that particular node.
♦ After each sending of Hello messages the node going to update its information state such as the neighbours list, tuple list.
♦ Also will update the MPR list by rechecking to the state of links of neighbours.

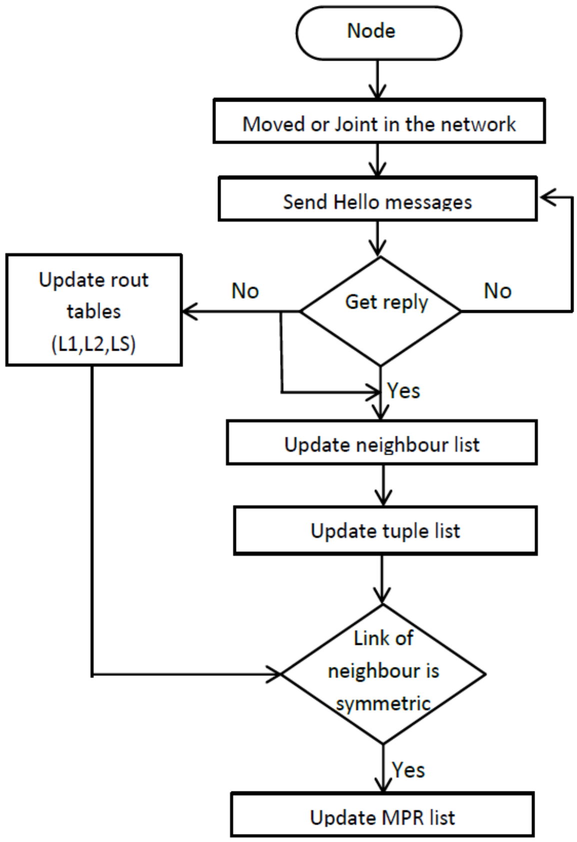
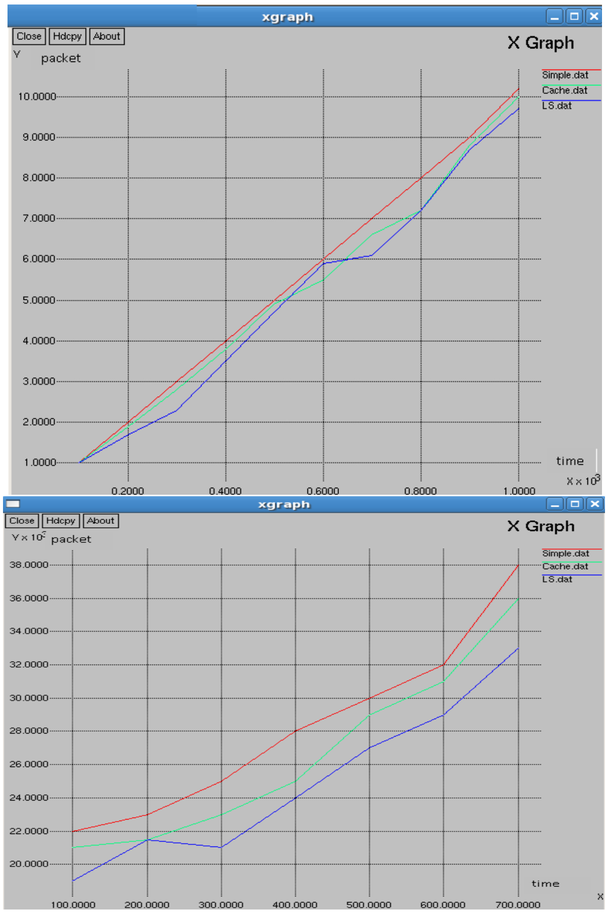


Fig 3: Flow Chart Mobility Handling and Node Function Management.

4. PERFORMANCE EVALUATION BY SIMULATIONS

For performance evaluations, we used the "Network Simulator 2"(NS-2, v29) to evaluate number of sent packets used for establishing path between source and destination within dynamic movement network**.** By using the proposed working we got minimum number of packets used for establishing path form same source to same destination in other approaches.
The following graphs (1),(2) shows number of sent packet for AODV using one cache memory (simple AODV) in red colour line, and AODV using two levels of cache memory in green colour line, and the proposed design in blue colour line.

Graph (1) show results tested on small network contains seven nodes.
This showing our approach has the minimum number of sent packets flooded in the network to establish path between source and destination.
The following test done on 50 nodes showing our approach also has the lowest load on the network for establishing paths between source and destination while changing the network topology.



Graph (2) Show results tested on medium network contains fifty nodes.

5. CONCLUSION

In this paper, we proposed an efficient Ad-Hoc On-demand Distance Vector routing algorithm, using the algorithm of Optimize link State Protocol. Where AODV protocol is responsible on Route DiscoveryAlgorithm,and OLSR protocol is responsible on the Mobility Handling and Node Functions Management. We got the benefits of both protocols AODV as reactive protocol and OLSR as proactive protocol. Also we ot the benefit from applied Two level of cache memory for each node level one L-1 and level two L-2, which are used to keep paths from the Route Discovery Algorithm . The most important control messages are used by AODV are RREQ, RREP, RERR, and the most important control messages used by OLSR as part of AODV are TC, Hello messages. We applied AODV protocol as the best protocol of reactive protocol because it already has feature of old AODV(old version without cache memory) which is loop free , and have features of DSR (which is have cache memory). We test our design by using the Network Simulator (NS 2.29). The simulation results show that our On-Demand Cache Routing with LS algorithm, outperforms the simple AODV using one level of cache, and AODV just with L1 and L2, in packet flooding number of packet to establish path from source to destination. We hope the On-demand routing using optimized link state algorithm would be a great contribution for MANET routing.

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